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Global and Local Temperature Fluctuations in High Energy Heavy-ion Collisions

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Heavy-ion collisions at ultra-relativistic energies create matter at extreme conditions of energy density and temperature, similar to the ones that existed within a few microseconds after the Big Bang. The fireball produced in the collision goes through a rapid evolution from an early partonic phase of deconfined quark-gluon plasma (QGP) to a hadronic phase and ultimately freezing out after a few tens of fm.
Temperature fluctuations have been discussed in the literature as a means of characterizing the evolving system. The fluctuations may have two distinct origins, first, quantum fluctuations that are initial state fluctuations, and second, thermodynamical fluctuations. We discuss a method of extracting the thermodynamic temperature from the mean transverse momentum of pions, by using controllable parameters such as centrality of the system, and range of the transverse momenta. Event-by-event fluctuations in global temperature over a large phase space provide the specific heat of the system. We present Beam Energy Scan of sp. heat from data, AMPT and HRG model prediction. For Pb-Pb collisions at the Large Hadron Collider (LHC) energies, because of the production of a large number of particles in every event, it is possible to divide the phase space into small bins and obtain local temperature for each bin. Event-by-event fluctuations in local temperature can be obtained by following a novel procedure of making fluctuation map of each event.
The origin of the local fluctuations has been studied with the help of event-by-event hydrodynamic calculations, which shows that the system exhibits fiercely large fluctuations at early times after the collision, which diminishes with the elapse of time. Any observation of non-zero local fluctuations may imply that a part of the early fluctuations might have survived till freeze-out. We discuss the hydrodynamic calculations and a feasibility study at LHC using AMPT simulated data.

On behalf of collaboration:

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